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Date: 12-6-04

Himanshu S. Amin

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of:

Applicant(s): Cyrus E. Tabery, *et al.*

Examiner: Parviz Hassanzadeh

Serial No: 09/955,517

Art Unit: 1763

Filing Date: September 18, 2001

Title: IN-SITU OR EX-SITU PROFILE MONITORING OF PHASE OPENINGS ON
ALTERNATING PHASE SHIFTING MASKS BY SCATTEROMETRY

**Mail Stop Appeal Brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450**

APPEAL BRIEF

Dear Sir:

Applicants submit this brief in connection with an appeal of the above-identified patent application. The Commissioner is authorized to deduct \$330.00 for the fee associated with this brief *via* the credit card payment form filed concurrently herewith. In the event any additional fees may be due and/or are not covered by the credit card, the Commissioner is authorized to charge such fees to Deposit Account No. 50-1063.

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I. Real Party in Interest (37 C.F.R. §41.37(c)(1)(i))

The real party in interest in the present appeal is Advanced Micro Devices, Inc., the assignee of the present application.

II. Related Appeals and Interferences (37 C.F.R. §41.37(c)(1)(ii))

Appellants, appellants' legal representative, and/or the assignee of the present application are not aware of any appeals or interferences which will directly affect, or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. Status of Claims (37 C.F.R. §41.37(c)(1)(iii))

Claims 1, 2, 4-20, 25 and 26 are pending in the application. Claim 3 has been cancelled and claims 21-24 have been withdrawn. The rejection of claims 1, 2, 4-20, 25 and 26 is being appealed.

IV. Status of Amendments (37 C.F.R. §41.37(c)(1)(iv))

No claim amendments have been made after the Final Office Action.

V. Summary of Claimed Subject Matter (37 C.F.R. §41.37(c)(1)(v))**A. Independent Claim 1**

Independent claim 40 and its corresponding dependent claims relate to a system that measures an etch of a mask feature. (*See e.g.* Application at p. 8, lines 1-3). The system includes one or more mask creating components that fabricate one or more features on an alternating aperture phase shift mask; a driving component that controls the one or more mask creating components; and an emitting component that directs light on to at least one of the features on the alternating aperture phase shift mask. (*See e.g.* Application at p. 8, lines 3-6). An analysis component is employed to measure one or more feature parameters based on a light reflected and/or refracted from the one or more features, the measured feature parameter utilized by the driving system to control the mask creating component during fabrication process and post-fabrication process in an alternating aperture phase shift mask. (*See e.g.* Application at p. 9, lines 1-4).

B. Independent Claim 15

Independent claim 15 and its corresponding dependent claims relate to a system for monitoring the profile of an aperture on an alternating aperture phase shift mask, the system. (*See e.g.* Application at p. 9, lines 5-7). The system includes a system for directing light onto an alternating aperture phase shift mask; and a measuring system for measuring one or more aperture parameters based on a light reflected from the aperture. (*See e.g.* Application at p. 9, lines 7-10).

C. Independent Claim 25

Independent claim 25 relates to a system for controlling a process for etching openings in an alternating aperture phase shift mask. (*See e.g.* Application at p. 9, lines 12-14). The system includes means for sensing at least one of the shape, location, depth, width and opening wall slopes of one or more apertures on the alternating aperture phase shift mask; means for etching one or more apertures on the alternating aperture phase shift mask; and means for selectively controlling the etching of the one or more apertures based on analysis of data collected by the means for sensing the shape, location, depth, width and opening wall slopes of the one or more apertures. (*See e.g.* Application at p. 9, lines 14-16).

D. Independent Claim 26

Independent claim 26 relates to a phase shift mask manufacturing component that fabricates one or more features on a phase shift mask. The phase shift manufacturing component includes a component that directs light on to at least one of the features on the phase shift mask; a processing component receives reflected and/or refracted and measures one or more feature parameters based on the light reflected and/or refracted from the one or more features; and a feedback component that utilizes the measurement of the phase shift mask to adjust the fabrication process.

VI. Grounds of Rejection to be Reviewed (37 C.F.R. §41.37(c)(1)(vi))

A. Whether claims 1, 2, 4-20, 25 and 26 are anticipated under 35 U.S.C. §102(e) over Kagoshima, *et al.* (US Patent Application Publication No. 2003/0003607 A1).

B. Whether claims 1, 2, 4-20, 25 and 26 are unpatentable under 35 U.S.C. §103(a) over Latos (US Patent 4,208,240) in view of Niu, *et al.* (Specular Spectroscopic Scatterometry in DUV Lithography).

VII. Argument (37 C.F.R. §41.37(c)(1)(vii))**A. Rejection of Claims 1, 2, 4-20, 25 and 26 Under 35 U.S.C. §102(e)**

Claims 1, 2, 4-20, 25 and 26 stand rejected under 35 U.S.C. §102(e) as being anticipated by Kagoshima, *et al.* (US Patent Application Publication No. 2003/0003607 A1). Reversal of this rejection is respectfully requested for at least the following reasons. Kagoshima, *et al.* does not teach or suggest the subject invention as recited in 1, 2, 4-20, 25 and 26. A single prior art reference anticipates a patent claim only if it expressly or inherently describes *each and every limitation* set forth in the patent claim. *Trintec Industries, Inc., v. Top-U.S.A. Corp.*, 295 F.3d 1292, 63 U.S.P.Q.2D 1597 (Fed. Cir. 2002); *See Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ 2d 1051, 1053 (Fed. Cir. 1987). The *identical invention* must be shown in as complete detail as is contained in the ... claim. *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Independent claim 1 (and similarly independent claims 15 and 25) recites a system that employs an analysis component to measure one or more feature parameters of an alternating aperture phase shift mask (AAPSM) based on a light reflected and/or refracted from the one or more features. The measured feature parameter is utilized by a driving system to control a mask creating component during fabrication process and post-fabrication process in the AAPSM. Kagoshima, *et al.* does not teach or suggest such claimed elements of the subject invention.

More particularly, Kagoshima, *et al.* does not teach or suggest a ***mask creating component*** that fabricates one or more features on an AAPSM. Instead, Kagoshima, *et al.* is directed to ***semiconductor fabrication*** and more particularly to a plasma processing control system utilized in a dry etching stage of semiconductor fabrication. Such fabrication does not contemplate the ***fabrication of a mask*** as recited in the subject claim. Instead, as disclosed in Kagoshima *et al.*, ***wafer/semiconductor fabrication*** employs a mask that has already been created to facilitate fabrication of the wafer/semiconductor. (See Application, page 1, paragraphs 3-10). Additionally, processes employed to fabricate a semiconductor do not include etching quartz to provide apertures with appropriate dimensions, as required for the fabrication of features in an AAPSM. (See Application, page 1, paragraph 3). Thus, Kagoshima *et al.* does not teach or suggest the manufacture and/or ***creating of a mask***, as recited in the subject claims.

In the Final Office Action dated August 12, 2004, the Examiner contends that “the AAPSM and the method of creating mask [sic] as recited in the claims is considered an intended use of the apparatus” and that these limitations do not “impart patentability into the claims.” (See page 3, paragraph 3). The applicants’ representative respectfully disagrees. Contrary to Examiner’s assertions, there is ample precedent to establish that functional limitations in claims are afforded patentable weight in making a determination of anticipation. The Federal Circuit has required functional language in an apparatus claim as requiring that an accused apparatus possess the capability of performing the recited function. *See, e.g., Intel Corp. v. U.S. Int’l Trade Comm’n*, 96 F.2d 821, 832, 20 USPQ 2d 1161, 1171 (Fed. Cir. 1991). Kagoshima, *et al.* does not disclose any reference to an AAPSM or of fabrication related thereto and the Examiner has proffered no evidence that the Kagoshima, *et al.* can be employed with an AAPSM. Hence, this reference does not anticipate the subject invention.

The subject invention employs particular techniques for the measurement of a phase shift mask (*e.g.*, AAPSM) that take advantage of the diffraction of light as it passes through one or more apertures on a mask employed in chip manufacturing. With feature sizes approaching and becoming smaller than the wavelength of the exposing light, the apertures and/or barriers on the mask have thus become closer to the wavelength of the exposing light. Thus, attention to diffraction in chip manufacturing has become more

pronounced since diffraction can lead to rounded features and features that do not have a desired size and/or shape. The subject invention is an improvement over conventional measurement techniques (*e.g.*, lithography) wherein light employed to measure a phase shift mask can provide inaccurate results since light waves can be diffracted and thus, expose undesired areas and/or features of the phase shift mask. The subject invention provides a system that facilitates monitoring, measuring and/or controlling the fabrication of openings (*e.g.*, apertures) specifically in *alternating aperture phase shift masks* to overcome such measurement deficiencies consonant with conventional techniques. As noted, the claimed invention is employed with fabrication of masks, and more particularly to the fabrication of AAPSM which are not employed with semiconductor fabrication.

Claims that contain functional limitations within a system can define the elements of the claim not only with respect to the structure but also the function of each element. As stated by the C.C.P.A., “there is nothing intrinsically wrong with defining a claim limitation by what it does rather than what it is. Indeed, the Court has recognized in the past practical necessity for the use of functional language.” *See, e.g., In re Swinehart*, 439 F.2d 210, 169 USPQ 226, 228-9 (C.C.P.A. 1971). Similarly, in *In re Land*, the CCPA noted that although portions of a claim were functional, such claims were held patentable over the prior art in view of the functional limitations. *See In re Land*, 368 F.2d 866, 151 USPQ 621 (C.C.P.A. 1966). Here, the claimed subject invention recites limitations related directly to an AAPSM including utilizing a mask creating component to fabricate one or more mask features on an AAPSM, emitting light on an AAPSM to measure such features and an analysis component that employs such measurements to control a mask creating component. In this manner, the function of the claimed invention is a limitation. Thus, although the claims relate to function, such limitations are adequate to overcome *Kagoshima, et al.*

Moreover, the Examiner has not provided evidence or reasoning to support the contention that the fabrication, measurement and analysis of an AAPSM is an inherent characteristic of *Kagoshima, et al.* As stated by the Board of Patent Appeals and Interferences in *Ex parte Skinner*, “the examiner must provide some evidence or scientific reasoning to establish the reasonableness of the examiner’s belief that the

functional limitation is an inherent characteristic of the prior art,” 2 USPQ 2d 1788 (B.P.A.I. 1987). *See also In re Chiang*, Civ. App. No. 94-114 (Fed. Cir. Nov. 23, 1994); *In re Weiss*, 26 USPQ 2d 1885 (Fed. Cir. 1993). Here, the Examiner has not met such a burden since there is no support that the creation of an AAPSM is inherently disclosed in *Kagoshima, et al.*

In addition, *Kagoshima et al.* does not teach or suggest utilizing a measured feature parameter of a mask by a driving system to control the mask creating component, as recited in the subject claim. The Examiner contends that ¶¶27-32 and 41-43 of *Kagoshima et al.* disclose such limitation. However, the sections cited by the Examiner are not directed to measured mask feature parameters that ***control a mask creating component***, as recited in the subject claims. Instead, the sections are directed to semiconductor/wafer fabrication, as noted above.

Moreover, *Kagoshima et al.* does not teach or suggest controlling a mask creating component during a mask fabrication process and ***a post mask fabrication process***. Rather, *Kagoshima et al.* contemplates activity only during fabrication such as “a semiconductor manufacturing step, wafer processing is carried out with manufacturing conditions...” (See p.1, ¶3). Thus, *Kagoshima et al.* does not contemplate ***post-fabrication processes*** as recited in the subject claims.

Further, *Kagoshima et al.* does not teach or suggest an analysis component wherein the measured mask feature parameter is utilized by the driving system to ***control the mask creating component***. The Examiner contends that element 24 of Fig. 7 discloses such a limitation. However, element 24 does not disclose utilizing a measured mask feature parameter to ***control a mask creating component*** during a mask fabrication process and post-fabrication process, as recited in the subject claim. Rather, element 24 relates to a sensor for “monitoring process parameters to measure the wafer immediately after etched within the etcher and to estimate dimensions and shape thereof” (See p.3, ¶43). Such a sensor does not interface to a ***mask creating component*** to control the mask fabrication. Instead, the sensors can be employed to estimate a processed result for a wafer and such an estimation can be compared to a target value. (See p.2, ¶30). Thus, an analysis component as recited in the subject claim is not disclosed in *Kagoshima et al.*

For at least the reasons stated in this section, the Examiner has failed to cite prior art that teaches or suggests each and every limitation of the subject claims. In particular, a mask creating component and the control of the mask creating component.

Accordingly, the Examiner has failed to establish a case of anticipation pursuant to 35 U.S.C. §102(e). In view of at least the foregoing, the subject claims are in condition for allowance and it is respectfully requested that the rejection of independent claims 1, 15 and 25 (and the claims that depend therefrom) be withdrawn.

B. Rejection of Claims 1, 2, 4-20, 25 and 26 Under 35 U.S.C. §103(a)

Claims 1, 2, 4-20, 25 and 26 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Latos (US Patent 4,208,240) in view of Niu, *et al.* (Specular Spectroscopic Scatterometry in DUV Lithography). Reversal of this rejection is respectfully requested for at least the following reasons. Latos and Niu, *et al.* individually and in combination do not teach or suggest the subject invention as recited in claims 1, 2, 4-20, 25 and 26. To reject claims in an application under §103, an examiner must establish a *prima facie* case of obviousness. A *prima facie* case of obviousness is established by a showing of three basic criteria. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. *See* MPEP §706.02(j). The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. *See In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Independent claim 1 (and similarly independent claims 15 and 25) recites one or more **mask creating components** employed to fabricate one or more mask features on an AAPSM. An emitting component directs light onto such features wherein the reflected and/or refracted light is employed to measure the features and thereby control the mask creating component during fabrication and post-fabrication processes. Latos and Niu, *et al.* individually and in combination do not teach or suggest all the limitations of the claimed subject invention.

Latos is directed to ***semiconductor fabrication*** and more particularly to an apparatus for controlling plasma etching. Such fabrication does not contemplate the ***fabrication of a mask*** as recited in the subject claim. Rather, as disclosed in Latos, plasma etching relates to a step in ***fabrication of a semiconductor***, which employs a mask ***already created*** to facilitate fabrication of the semiconductor. (See p.1, ¶¶3-10). Thus, Latos does not teach or suggest the manufacture and/or ***creating of a mask***, as recited in the subject claims. Niu, *et al.* does not make up for such deficiencies of Latos.

The motivation given by the Examiner to combine the references is improper since neither reference contemplates a ***mask creating component***, as recited in the subject claim. In other words, since neither Latos nor Niu, *et al.* mention mask fabrication, let alone the fabrication of an AAPSM, there can be no motivation to combine such references to be utilized for the fabrication of any mask including an AAPSM, as recited in the subject claims. Thus, the Examiner's burden to show a motivation to combine Latos and Niu *et al.* is not met and the combination of such references is improper. The prior art items themselves must suggest the desirability and thus the obviousness of making the combination without the slightest recourse to the teachings of the patent or application. Without such independent suggestion, the prior art is to be considered merely to be inviting unguided and speculative experimentation which is not the standard with which obviousness is determined. *Amgen, Inc. v. Chugai Pharmaceutical Co. Ltd.*, 927 F.2d 1200, 18 USPQ2d 1016 (Fed. Cir. 1991); *In re Laskowski*, 871 F.2d 115, 117, 10 USPQ2d 1397, 1398 (Fed. Cir. 1989); *In re Dow Chemical Co.*, 837 F.2d 469, 473, 5 USPQ2d 1529, 1532 (Fed. Cir. 1988); *Hodosh v. Block Drug*, 786 F.2d 1143 n. 5., 229 USPQ at 187 n. 4.; *In re Gordon*, 733 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1985).

Moreover, the combination of Latos with Niu, *et al.* does not teach all the limitations (e.g., elements) of the subject invention. As noted previously, neither Latos nor Niu, *et al.* contemplate or disclose the fabrication, measurement and/or analysis of an AAPSM, as recited in the subject claims. It is essential to consider all elements of the claimed invention; it is impermissible to compare the prior art with what the viewer interprets the "gist" of the invention to be *Vas-Cath Inc. v. Mahurkar*, 935 F.2d 1555, 19 USPQ2d 1111 (Fed. Cir. 1991); *Perkin-Elmer Corp. v. Computervision Corp.*, 732 F.2d

888, 221 USPQ 669 (Fed. Cir. 1984); *Jones v. Hardy*, 727 F.2d 1524, 1527-28, 220 USPQ 1021m 1024 (Fed. Cir. 1984). As discussed previously, the subject invention relates generally to measurement of *mask features* and more specifically to utilizing an analysis component to control a mask creating component during fabrication. It is respectfully submitted that the neither Latos nor Niu, *et al.*, singly and/or in combination teach, suggest or make obvious the limitation of utilizing a *mask creating component* during fabrication of a mask as recited in the subject claim.

In view of at least the foregoing, it is respectfully submitted that Latos and Niu, *et al.* individually and in combination do not make obvious applicants' invention as recited in independent claims 1, 15 and 25 (and claims 3-14 and 16-20 which depend therefrom), and this rejection should be withdrawn.

C. Conclusion

For at least the above reasons, the claims currently under consideration are believed to be patentable over the cited references. Accordingly, it is respectfully requested that the rejections of claims 1, 2, 4-20, 25 and 26 be reversed.

A credit card payment form is filed concurrently herewith in connection with all fees due regarding this document. In the event any additional fees may be due and/or are not covered by the credit card, the Commissioner is authorized to charge such fees to Deposit Account No. 50-1063.

Respectfully submitted,
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VIII. Claims Appendix (37 C.F.R. §41.37(c)(1)(viii))

1. A system that measures an etch of a mask feature, comprising:
one or more mask creating components that fabricate one or more features on an alternating aperture phase shift mask;
a driving component that controls the one or more mask creating components;
an emitting component that directs light on to at least one of the features on the alternating aperture phase shift mask; and
an analysis component that measures one or more feature parameters based on a light reflected and/or refracted from the one or more features, the measured feature parameter utilized by the driving system to control the mask creating component during fabrication process and post-fabrication process in an alternating aperture phase shift mask.
2. The system of claim 1, comprising a processor operatively coupled to the measuring system and the fabricating component driving system.
3. (Cancelled)
4. The system of claim 1, the fabricating components are etching components.
5. The system of claim 1, the features comprise at least one of an aperture and a grating.
6. The system of claim 1, the analysis component comprises a scatterometry system for processing the light reflected from the one or more features.
7. The system of claim 1, the fabricating components are etching components.

8. The system of claim 1, the features comprise at least one of an aperture and a grating.

9. The system of claim 1, the processor maps the mask into a plurality of grid blocks and makes a determination of fabrication conditions at the one or more grid blocks.

10. The system of claim 1, the fabrication conditions comprise at least one of the depth, width and profile of the features.

11. The system of claim 1, the processor determines the existence of an unacceptable fabrication condition for the one or more features based upon a determined feature signature differing from an acceptable feature signature.

12. The system of claim 2, the processor controls the one or more fabricating components to regulate fabricating the one or more features on the mask.

13. The system of claim 1, the features comprise at least one of an aperture and a grating.

14. The system of claim 1, the fabricating components are etching components.

15. A system for monitoring the profile of an aperture on an alternating aperture phase shift mask, the system comprising:

a system for directing light onto an alternating aperture phase shift mask; and a measuring system for measuring one or more aperture parameters based on a light reflected from the aperture.

16. The system of claim 15, the aperture parameters comprise at least one of aperture depth, aperture width and aperture wall slope.

17. The system of claim 15, comprising a processor adapted to receive aperture data from the measuring system and to facilitate determining whether the alternating aperture phase shift mask has been fabricated within one or more pre-determined tolerances.

18. The system of claim 17, the pre-determined tolerances comprise at least one of aperture depth, aperture width and aperture wall slope.

19. The system of claim 15, the measuring system comprises a scatterometry system for processing the light reflected from an aperture to determine an aperture signature.

20. The system of claim 15, the processor determines whether the mask has been fabricated within one or more pre-determined tolerances based upon a determined aperture signature differing from an acceptable aperture signature.

21. (Withdrawn) A method for monitoring and controlling aperture etching in an alternating aperture phase shift mask, comprising:

etching one or more apertures on the alternating aperture phase shift mask;
directing light onto at least one of the one or more apertures;
collecting light reflected from the at least one aperture;
employing scatterometry to analyze the reflected light to determine at least one of the depth, shape, location, profile and width of the at least one aperture; and
selectively controlling the etching of the one or more apertures in the mask.

22. (Withdrawn) The method of claim 21 comprising:
etching one or more gratings on the alternating aperture phase shift mask;
directing light onto at least one of the one or more gratings;
collecting light reflected from the at least one grating; and
employing scatterometry to analyze the reflected light to determine at least one of the depth, shape, location, profile and width of the at least one grating.

23. (Withdrawn) A method for determining whether an alternating aperture phase shift mask has been fabricated with desired aperture etching parameters, comprising:

etching one or more apertures on the alternating aperture phase shift mask;
directing light onto at least one of the one or more apertures;
collecting light reflected from the at least one aperture;
employing scatterometry to analyze the reflected light to determine at least one of the depth, shape, location, profile and width of the at least one aperture; and
determining the acceptability of the alternating aperture phase shift mask based on at least one of the depth, shape, location, profile and width of the at least one aperture.

24. (Withdrawn) The method of claim 23 comprising:

etching one or more gratings on the alternating aperture phase shift mask;
directing light onto at least one of the one or more gratings;
collecting light reflected from the at least one grating; and
employing scatterometry to analyze the reflected light to determine at least one of the depth, shape, location, profile and width of the at least one grating.

25. A system for controlling a process for etching openings in an alternating aperture phase shift mask, comprising:

means for sensing at least one of the shape, location, depth, width and opening wall slopes of one or more apertures on the alternating aperture phase shift mask;

means for etching one or more apertures on the alternating aperture phase shift mask; and

means for selectively controlling the etching of the one or more apertures based on analysis of data collected by the means for sensing the shape, location, depth, width and opening wall slopes of the one or more apertures.

26. A phase shift mask manufacturing component that fabricates one or more features on a phase shift mask, comprising:

 a component that directs light on to at least one of the features on the phase shift mask;

 a processing component receives reflected and/or refracted and measures one or more feature parameters based on the light reflected and/or refracted from the one or more features; and

 a feedback component that utilizes the measurement of the phase shift mask to adjust the fabrication process.

IX. Evidence Appendix (37 C.F.R. §41.37(c)(1)(ix))

None.

X. Related Proceedings Appendix (37 C.F.R. §41.37(c)(1)(x))

None.